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A NATURAL HYBRID OF POLYSTICHUM
LONCHITIS AND P. ACROSTICHOIDES
FROM THE BRUCE PENINSULA

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Polystichum lonchitis, the northern holly-fern, is a circumboreal species which occurs in eastern North America in Quebec, Cape Breton Island, Ontario, and northern Michigan. The endemic *P. acrostichoides*, the familiar Christmas fern, occurs in these areas too, but it also extends southward into Texas, Florida, and Mexico. In the Bruce Peninsula, Ontario, the writers found these two species growing in close proximity near Cape Croker. *P. lonchitis* is prevalent here on a rocky, dolomite hillside above a swamp, while *P. acrostichoides* abounds locally along the swamp margins, and the two species intermingle in certain places. In hope that a hybrid of these two ferns might be discovered, a special search was made at this locality. Although no hybrid has been previously recorded between these two ferns, such a plant would be of special interest in regard to the genetic effect of combining the features of a fern (*P. acrostichoides*) with strongly dimorphic pinnae, the fertile ones sharply distinguished morphologically from the sterile, with the features of a fern (*P. lonchitis*) with monomorphic and undifferentiated pinnae. The only previously reported *Polystichum* hybrid in eastern North America is *P. braunii* × *P. acrostichoides* (Thompson and Coffin 1940), but the anatomical features of the fertile pinnae of this hybrid were not investigated.

Our search for a hybrid was rewarded by finding a single, extremely large plant of obviously intermediate morphology, the spores of which are abortive, i.e., the sporangia contained bodies

of irregular sizes and shapes. The previous year's fronds of the two parents bore normal spores, where these were present. A number of fronds were collected for the study of the hybrid and the parent species growing near it, both in the spring of 1952 and in the fall of 1953, but the hybrid plant was left growing. The intermediate is considerably larger than either of its parents, and is obviously extremely vigorous in growth. When we first observed it the previous year's fronds were still bright green, and a large number of nearly uncurled crosiers of this year's leaves were evident.

The hybrid was found at the west edge of the Cape Croker Indian Reservation, Bruce County, Ontario, at approximately 44° 52' North and 81° 4' West. The station is on the southeastern slope of a rocky hill at the top of the Niagara escarpment, here present as a series of terraces instead of the bold cliffs found close to Georgian Bay. The height of the plateau here is approximately 950 feet above sea level. Along the south side of the hill the dolomite of the Niagara formation is exposed in small bluffs up to 30 feet high, rising abruptly from the edge of a swamp. On the southeast the slope is more gentle, and an old pasture comes nearly to the foot of the slope. The second-growth woods which covers the hill is chiefly sugar maple and basswood, while elms grow in the swampy area. *Polystichum acrostichoides* is abundant and luxuriant along the swamp margin, and a few plants were also found near the edge of the woods along the old pasture. *P. lonchitis* is common along the rocky top of the hill, and is found on ledges and slopes along the hillside. Other ferns found in these woods are *Dryopteris filix-mas*, *D. intermedia*, *D. marginalis*, *Adiantum pedatum*, and *Botrychium virginianum*. Among the herbs are *Geranium robertianum*, *Viola canadensis*, *Maianthemum canadense*, *Polygonatum biflorum*, and *Hepatica acutiloba*. The hybrid fern is at the base of a low hummock about 20 yards from the edge of the woods along the old field. The nearest plants of *P. acrostichoides* are about 10 yards away, while plants of *P. lonchitis* are about 5 yards away.

Examination of Plate 1198 will reveal some of the salient features of the hybrid. In aspect it is intermediate between the two parents, although larger in over-all dimensions than either, and the pinna number of the hybrid, which averages 55.5 pairs

(53–59) is greater than *P. lonchitis* with 41 pairs (35–47) and much greater than *P. acrostichoides* with an average of 31 pairs (26–34). In all probability the excessively high number of pinnae of the hybrid is correlated with the obviously more vigorous growth and larger size of the plant in comparison with its parents.

In our later study of the hybrid the question arose whether it might not, in fact, be merely a monstrous form of the polymorphic *P. acrostichoides*, of which Fernald (1950, pp. 38–39) in Gray's Manual, 8th Ed., gives seven forms, and Brooks (1947, p. 24) described an eighth which "differs from the typical form of the species in having fronds strongly resembling *P. lonchitis* . . ." With regard to the last, it was possible to compare our plant with *P. acrostichoides* var. *lonchitoides* Brooks, through the kindness of Dr. Brooks, and the Herbarium of the University of West Virginia. This variety, which was collected in the neighborhood of French Creek, Upshur County, W. Va., is a much smaller plant than ours, and differs from the hybrid in having more leathery texture, shallowly and coarsely dentate pinna margins, and conspicuously dimorphic pinnae. Examination of the other obvious features of var. *lonchitoides* reveals that it is undoubtedly merely another of the forms of *P. acrostichoides* as it was originally considered to be. The number of pinna pairs is like that in typical *P. acrostichoides*, but the shortness of the pinnae gives the frond an unusually narrow appearance, and thus a resemblance to *P. lonchitis*.¹ In our plant, on the other hand, numerous obvious points of comparison show it to be a true intermediate between the putative parents.

The petiole-length: blade-length ratio in *Polystichum acrostichoides* is approximately 1 : 2.7, while that of *P. lonchitis* is 1 : 7.7. In the hybrid it averages about 1 : 6.4. One of the most distinctive contrasts in the parents is in respect to the lowest pinnae: in *P. acrostichoides* specimens from the Cape Croker locality the lower pinnae are but little reduced in size, as is typical of this

¹ The brief description of *P. acrostichoides* var. *lonchitoides* Brooks may be expanded here as follows: A narrow form of *P. acrostichoides*, with linear-oblong fronds, 30–45 cm. long, 2.6–3.6 cm. broad; the pinnae coriaceous, slightly crenate to coarsely and shallowly dentate, short-oblong-ovate, obtuse or rounded at the tips, 12–18 mm. long, 5–8 mm. broad, with the anterior basal auricle usually separated by a deep sinus from the rest of the pinna; the stipes densely fulvous-scaly; lower pinnae deflexed but not reduced in length more than one-half the length of the largest median pinnae; fertile pinnae contracted and pinnatifid. Type: French Creek, Upshur Co., W. Va., December 26, 1934. Maurice Brooks. (in Herb. Univ. W. Va.).

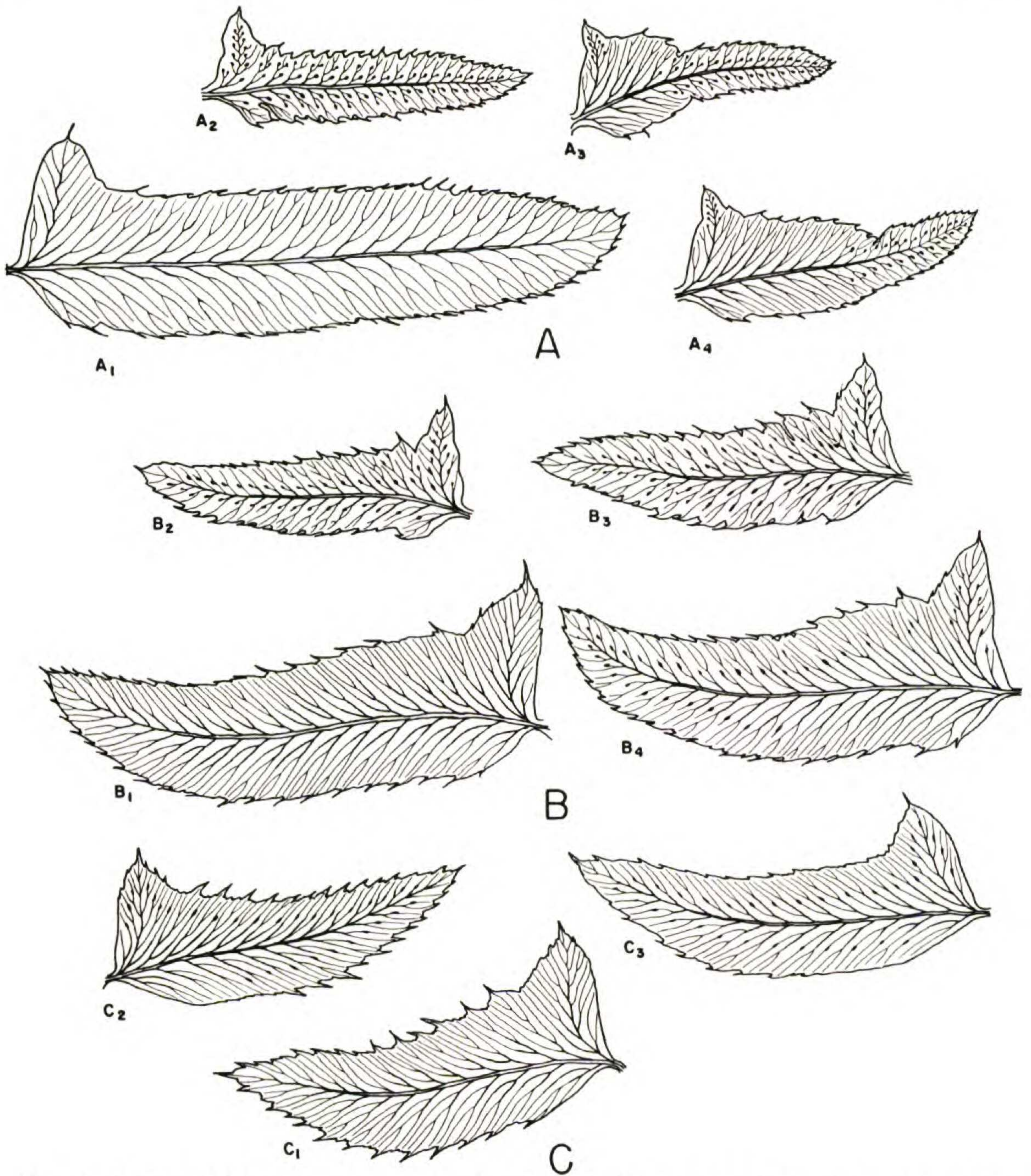


Fig. 1. Pinnae of *Polystichum* (Specimens from Cape Croker, Bruce Co., Ontario, except a_1 from Orange Co., N. Y., Raup 7300): A. *P. acrostichoides*; B. hybrid; C. *P. lonchitis*.

species, but the *P. lonchitis* specimens show much-reduced basal pinnae. In the former the ratio of length of the lowest pinnae to the length of the largest median pinnae is 4.4 (2.9–5.6) cm.: 5.1 (4.0–6.9) cm., and in the latter it is 1.0 (0.7–1.2) cm.: 2.4 (2.0–2.8) cm. In the hybrid the ratio is 1.7 (1.3–2.1): 3.5 (2.8–

3.9) cm. As shown in Fig. 1 the pinnae of *P. acrostichoides* are more distant than in either the hybrid or *P. lonchitis*. In *P. acrostichoides* the median pinna bases average 1.3 cm. distant from each other, in the hybrid 1.1 cm., and in *P. lonchitis* 0.9 cm. In the pinna outlines, likewise, the new plant is intermediate, not quite as oblong as in *P. acrostichoides* nor as obliquely falcate as in *P. lonchitis*.

The anatomical features of the fertile pinnae of the hybrid possess unusual interest because they combine two sharply distinct types of fertile veins. The fertile pinnae of *P. acrostichoides* differ from those of more typical species of this genus, not only in being strongly dimorphic, but in having a distinctive type of soral relationship to the veins. This relationship in *P. acrostichoides* differs from Copeland's (1947, p. 108) generic description: while the sori of *P. lonchitis* conform to his description of "sori dorsal on the veins," the sori of *P. acrostichoides* are *terminal* on modified veinlets, as shown in Fig. 1, A, where the sori have been removed to expose the club-like "fertile veins" which subtend each sorus. Every fertile vein in this species terminates abruptly at the position of the sorus, so that the sorus is terminal on the veinlet, in contrast to the situation in *P. lonchitis*, where the special mass of tracheids which subtends the sorus is a dorsal enlargement of an otherwise unmodified, and continuous, vein which extends to the margin of the pinna. (Fig. 1, C₂ and C₃).

The fertile pinnae of the hybrid are strikingly intermediate in respect to the fertile-vein structures of the parents. Fig. 1, B₂-B₄, illustrates different degrees of sorus production on several pinnae, B₂ and B₃ being the most soriferous. It will be observed that some of the fertile tracheid masses subtending sori are dorsal on the veins as in *P. lonchitis*, while others are terminal on the veins as in *P. acrostichoides*. But there is considerable irregularity in this respect, as some of the fertile veins have slender prolongations that extend only a short distance toward the margin, others have thicker ones which run all the way to the margin, and some have no distal projections at all.² Thus

² Morphogenetically one point especially should perhaps be stressed concerning the fertile veins of this hybrid, namely that the soral positions are regular and symmetrical in relation to the whole pinna. In theories of soral evolution stress has been laid by Bower and others on whether sori are on vein endings or on the sides of veins; considerable importance has been attached to the relationship of the sorus to

there is illustrated here in the minute anatomy of the fertile pinnae the sort of "irregularity phenomenon" which is observed elsewhere in the over-all leaf cutting of fern hybrids, where the parents have widely different leaf-forms (e.g., *Camptosorus* × *Asplenium* and *Dictyoxiphium* × *Tectaria*).

The contraction of the pinnae of the hybrid is so subtle that it does not show as well in the patterns of individual fertile and sterile pinnae as it does on the whole fronds. Examination of Plate 1198 will show that there is indeed a contraction of the fertile pinnae of the hybrid, although it is not nearly so conspicuous as in *P. acrostichoides*. In *P. lonchitis*, by contrast, the fertile pinnae tend actually to be slightly larger than the lower, sterile pinnae, but otherwise match them in almost every detail.

Examples of the hybrid described here will be deposited in the Gray Herbarium, National Herbarium, University of Michigan Herbarium, and the Herbarium of the Cranbrook Institute of Science.—UNIVERSITY OF MICHIGAN AND CRANBROOK INSTITUTE OF SCIENCE.

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its vein. Dickason (*Ohio Journ. of Sci.* 46: p. 98, 1946) wrote that "A distinction between sori which are apical on veins and those which are lateral on them is far more fundamental than a distinction between sori which are marginal and those which are 'superficial' on the abaxial surface, inasmuch as sori apical on veins may be either marginal or superficial," and he divides fern genera into two great groups on this basis. Holttum (*Biol. Rev.* 24: 271-272, 1949) says that "by more than one series of [evolutionary] changes the sorus may have become dorsal instead of terminal on its vein . . ." and thus again stresses the vein-sorus relationship.

One might expect, then, if vein-sorus relationship were the governing one in sorus position that the present hybrid might show various soral positions—sori terminal on long veins, terminal on short veins, dorsal on long veins, and dorsal on short-veins, and thus have an irregular soral pattern in relation to the whole pinna. But such is not the case: the sori themselves are symmetrical in position; the only variable is the veins themselves. The veins fluctuate around fixed sori.